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ABSTRACT

Many are concerned that America will not have a sufficient supply of scientists and engineers in the workforce for the 21st century. Five regional workshops were held to provide a forum for all those concerned with issues involved in the underrepresentation in science and engineering of students with disabilities. This document is one of two documents that was distributed through the participating national organizations. It is a "how-to" manual based upon the project's prototype model. The guide explains the format, procedures, and rationale for the model workshop. The guide includes a listing of key points to be made in panel presentations, identifies resources, and identifies prospective participants and discusses how to recruit them. Seven appendices include a workshop evaluation form, a list of materials and organizations, and a workshop planning checklist. (ZWH)

PLANNING GUIDE

Model Undergraduate Project for the Disabled: A Study of Issues Involved in Underrepresentation

PLANNING AND CONDUCTING A WORKSHOP ON CAREER ACCESS: SCIENCE AND ENGINEERING FOR STUDENTS WITH DISABILITIES

Conducted by:

National Association for Industry-Education Cooperation

In Cooperation with:

American Association for the Advancement of Science
Association on Higher Education and Disability
National Parent Network on Disability, Federation for Children with Special Needs

National Science Foundation
Directorate for Education & Human Resources
Division of Undergraduate Science, Engineering and Mathematics Education

Grant No. HRD-9054022

January 31, 1994

The National Association for Industry-Education Cooperation (NAIEC) is a nationally recognized and utilized resource in the promotion, development and expansion of industry-education cooperation efforts directed at furthering school improvement, the education-to-work process and human resource/economic development with a strong structural base. Headquartered in Buffalo, NY, the Association publishes a bi-monthly newsletter to association members, sponsors an annual industry-education "Showcase Conference," and conducts regional workshops to encourage industry-education programs at the public school and postsecondary levels and to "showcase" present working examples of selected industry-education collaborative programs. NAIEC serves as the National Clearinghouse on Industry Involvement in Education. NAIEC has worked closely with over 26 states, Great Britain and Canada, helping them develop networks of local industry-education councils, coordinated by state industry-education coordinators, and supported by key leaders in education, business, government, labor, and the professions. Central to the Association's mission and goals is the promotion and development of a dynamic and responsive public/private/postsecondary educational system and competitive work force through a comprehensive systemwide industry-education alliances focusing on cooperative planning, curriculum revision, staff development, upgrading instructional materials and equipment, and improving the efficiency and effectiveness of educational management. To accomplish this, key strategies include increasing technical assistance to communities in the U. S. and Canada in all areas of industry-education cooperation, conducting research, and broadening its leadership role through liaison/collaboration with private and public agencies and organizations.

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I. INTRODUCTION

During 1992 and 1993, the National Association for Industry-Education Cooperation conducted five regional workshops to study issues involved in the underrepresentation in science and engineering of students with disabilities. Formal presentations were given by representatives of the four participating organizations: (1) National Association for Industry-Education Cooperation—industry's need for scientists and engineers and career implications for students with disabilities; (2) American Association for the Advancement of Science—education and career experiences from practicing scientists and engineers with disabilities; (3) Association on Higher Education and Disability—disabled student service programs in colleges and universities; and, (4) National Parent Network on Disability, Federation for Children with Special Needs—parents' concerns and experiences.

The workshops were held in Boston, Minneapolis, Seattle-Tacoma, Phoenix-Tempe, and Atlanta. Participants included senior high school and college undergraduate students with disabilities, parents of students with disabilities, college and university science and engineering program administrators and faculty, secondary special education program administrators and teachers, college and university disabled student service program directors, practicing scientists and engineers with disabilities, and representatives from business and industry.

Group participation activities, emphasizing the Nominal Group Technique process, were successful in generating high levels of involvement among workshop participants. Participant evaluations were above 80% positive in two workshops, above 75% positive in two workshops, and above 65% positive in one workshop. The workshop model proved to be an effective method for identifying barriers to career access and developing strategies for their removal or alleviation. Participants, numbering 285 total, identified 382 barriers to career access and developed 373 strategies to overcome them.

The project produced two publications, including this one.

A conference proceedings document, Improving Career Access in Science and Engineering for Students with Disabilities, contains the formal presentations of the four national organization representatives, a summary of the identified barriers and recommended strategies to overcome them, summaries of workshop evaluations, and recommendations.

This workshop guide, Planning and Conducting a Workshop on Career Access: Science and Engineering for Students with Disabilities, is a "how-to" manual based upon the project's prototype model. The guide explains the

format, procedures, and rationale for the model workshop. The guide includes a listing of key points to be made in panel presentations, identifies resources available to you, and discusses prospective participants and how to recruit them.

The project recommended that the National Science Foundation and participating organizations promote the utilization of the workshop model for studying factors related to underrepresentation in other regions across the country. The workshop can provide the catalyst for energizing resources in a given area and building networks for collaborative efforts between parents, students, institutions of higher education, schools, and industry.

WORKSHOP PROGRAM

(Sample Format)

8:30 a.m.

Registration

9:00 a.m.

Welcome and Opening Remarks

9:15 a.m.

Presentations

- Industry Representative
- Panel of Practicing Scientists and Engineers with Disabilities
- Disabled Student Services Program Director
- Parent of a Student with a Disability

10:30 a.m.

Break

10:45 a.m.

Question and Answer Session

Includes All Presenters

11:30 a.m.

Lunch

Optional: Show Video Tape "Science-Able"

12:30 p.m.

Small Group Sessions

Using Nominal Group Technique to Develop Strategies

2:00 p.m.

Break

2:15 p.m.

Reports and Discussion of the Small Group Sessions

2:45 p.m.

Workshop Evaluation and Concluding Remarks

II. PLANNING THE WORKSHOP

Coordinator's Role

Someone must be identified for, or assume the role of, the workshop coordinator. The workshop coordinator is the person at the local level who coordinates the people and resources of participating organizations, arranges for the faculty, assists with the recruitment of workshop participants, identifies speakers and presenters, handles registration, special services, and other logistical matters, arranges for meal services, and recruits and orients the small group session facilitators. It is a challenging and very rewarding role, and is ideal for the person who likes to be a catalyst, one who likes to energize others around a cause or mission, and who displays the commitment and professionalism that commands the respect of others. The person who fills the coordinator's role can come from industry, higher education, or the consumer sector (e.g., a parent-advocate). The coordinator does not do it all alone, however. The coordinator depends on the time and effort of many others.

(Author's Note: From this point on in the Planning Guide it is assumed that the reader is the person filling the coordinator's role.)

Planning Team

As an initial step, you should form a planning team to assist with the workshop. Team members should represent the important stakeholders, including representatives of: disabled student services in higher education, business and industry, college/university science and engineering faculty and administrators, high school science, mathematics and technology teachers, special education teachers and administrators, rehabilitation counselors, secondary students with disabilities, college students with disabilities, practicing scientists and engineers with disabilities, and parents of students with disabilities. A planning team of seven to nine members representing these different constituencies is a good size group to work with. Within a given geographical area, either local or regional, the planning team may represent several colleges, community colleges and universities, several school districts, one or more parent organizations, numerous businesses and industries which recruit and hire scientists and engineers, and the disability community.

Who Should Be Involved?

A broad cross-section of people should be involved, especially including the following:

- high school student with a disability and an interest in science and engineering

- college student with a disability and an interest in science and engineering
- parent of a student with a disability who is interested in career opportunities in science and engineering
- college faculty member teaching in a science and/or engineering field
- college science or engineering department head
- secondary special education teacher
- special education program administrator
- high school science, mathematics, or technology teacher
- director or staff member of a college program providing services to students with disabilities
- rehabilitation counselor
- high school guidance counselor
- practicing scientist or engineer with a disability
- representative of business/industry with an interest in hiring, promoting, training and developing persons with disabilities for careers in science and engineering

The total number of workshop participants should not exceed 100 persons. Once the number goes higher, it prohibits the effectiveness of the small group sessions, which are an important part of the workshop. And, if more than that number applies, keeping a good balance between all of the areas mentioned above would be important, even though some individuals may have to be turned away.

Where Should the Workshop Be Held?

An essential requirement is that the facility be barrier-free! The American Association for the Advancement of Science has published Barrier Free Meetings: A Guide for Professional Associations which should be referred to in evaluating the facilities you are considering (Project on Science, Technology, and Disability, 1991). Factors you should also keep in mind are central location, parking, and cost. In descending order of preference, consider the following: corporate facilities, university centers, small colleges, science museums, and secondary schools. The local mayor's committee on persons with disabilities may also be a helpful resource to you in locating a desirable and suitable facility. The more closely the facility can be identified with careers in science

and engineering, the better. Some of the facilities used in our workshops included Stone and Webster Engineering in Boston, Honeywell in Minneapolis, and Southern College of Technology in Atlanta.

Logistical Concerns

Once the facility has been selected, and the date for the workshop has been set, you can begin to nail down some of the nitty-gritty items. These include room set-up, audio-visual equipment requirements, registration area, and services for the meal and breaks. You should be able to provide coffee and danish in the morning, a nice lunch, and afternoon soft drinks, cookies and fruit for a total of $10.00 per person. The lunch menu could be a cold plate or soup and sandwich, usually available at $5 or $7. Special dietary needs of workshop participants will need to be taken into consideration, but otherwise, the food services should be kept fairly simple. The cost of the food may be borne by the participants through a small registration fee, or, you may be able to obtain corporate support for this, especially if you are using a corporate facility.

Interpreter services and specialized equipment, e.g., for persons with visual disabilities, may need to be arranged. Interpreter services and special equipment may be available at low cost or on a loan basis through a college disabled student service program, the local rehabilitation services, university special education department or library, special education program, or a public/private agency.

Identifying Speakers and Presenters

To give the welcoming and opening remarks, consider having someone from the host organization. For example, this could be the company president or another officer if your workshop is hosted by a corporation. It could be a university administrator or college dean if your workshop is hosted by an institution of higher education. Or, you may want to handle this yourself. The opening remarks should include a brief welcome, express appreciation to the attendees, outline the purpose of the workshop and the activities for the day, and deal with any housekeeping items, e.g., location of restrooms, arrangements for breaks and lunch, etc.

The industry representative should be an individual from a company that recruits and employs scientists and engineers. You can identify such companies in your community by contacting the local chamber of commerce, employment agency, or through other community contacts. Preferably, the representative should be familiar with the capabilities of persons with disabilities and able to articulate the advantages to business and industry of hiring qualified persons with disabilities to fill important positions in his/her own organization and in other companies. For this presentation, you could also consider a government

representative from an organization (e.g., National Aeronautics and Space Administration) that is heavily involved in science and engineering. The **key points** to be made by the industry representatives include:

- Occupational growth in science and engineering fields indicates openings may go unfilled
- Demonstrated capabilities of individuals with disabilities to pursue careers in science and engineering
- College students with disabilities are seriously under-represented in science and engineering studies
- Barriers to career access in science and engineering begin in secondary school years, or even earlier
- Significant role can be played by parents in fostering their son's or daughter's interest in science and engineering

The panel of practicing scientists and engineers with disabilities can be drawn from your own sources and those known to members of your planning team. Another excellent resource for identifying these individuals is the American Association for the Advancement of Science's (AAAS) Project on Science, Technology and Disability. This AAAS project maintains a resource group of over 1,000 scientists and engineers with disabilities who are available for speaking engagements and consultation in areas of technical expertise and career choices. For information about the AAAS resource group and other resources, contact:

American Association for the Advancement of Science
Directorate for Education and Human Resources Programs
Project on Science, Technology and Disability
1333 H Street, N.W.
Washington, DC 20005
(202) 326-6630 — Voice/TDD
Virginia W. Stern, Director
Laureen Summers, Program Associate

You should try to have three or four panel members, with some diversity in terms of race, sex, disability, age, and types of careers. The **key points** that you want the panel members to address include:

- Personal, educational and career history
- Barriers they faced in pursuing their careers in science and engineering

- Factors which helped them to overcome the barriers, e.g., people, technology, institutions, and so on
- Accommodations in college and in the workplace, if these were required

Someone to speak about disabled student services programs can come from a local college or university which has these services available. Preferably, you would want to have a director with some experience working with students and faculty in science and engineering fields. If you don't have someone from the local area to fill this spot, you can contact the Association on Higher Education and Disability (AHEAD) for suggestions and support. AHEAD can be reached at:

Association on Higher Education and Disability
P.O. Box 21192
Columbus, OH 43221
(614) 488-4972 — Voice/TDD
Dr. Jane Jarrow, Executive Director

The **key points** to be addressed by the program representative are:

- Types of services available at colleges and universities
- How students with disabilities access these services
- Differences between educational rights and responsibilities at the secondary level and educational rights and responsibilities in higher education

The presentation on parents' concerns and experiences should be given by a parent of a student with a disability, preferably a student in high school or attending college. A parent from a local disability organization or advocacy group who can address these topics from personal experience can be very effective. If you need assistance in locating a parent speaker, you may want to contact the Federation for Children with Special Needs which coordinates a national network of parent education centers. They can be contacted at:

National Parent Network on Disability
Federation for Children with Special Needs
95 Berkeley Street
Suite 104
Boston, MA 02116
(617) 482-2915
Martha H. Ziegler, Executive Director

Key points to be addressed by the parent include:

- Personal experiences with their son or daughter
- Barriers which they ran into and had to overcome
- Factors which assisted studies in science and engineering

A brief statement of background information is included in Appendix A. This piece provides a general review of the issues related to career access. You will want to review this yourself and also provide it to prospective and/or selected presenters.

Recruiting Participants and Small Group Facilitators

Use the planning team to develop mailing lists of potential participants. For example, a business/industry representative could use contacts with the Chamber of Commerce, local chapter of American Society of Training and Development, societies of engineers and scientists, and networks of human resource development specialists and personnel officers in local companies and organizations to compile a good list of potential business/industry participants. Many of these persons would also know practicing scientists and engineers with disabilities within their organizations.

A team member affiliated with a disabled student services program at a local college or university could contact counterparts at other institutions of higher education, as well as provide outreach to faculty and administrators in the science and engineering schools and departments. Professionals affiliated with the Association on Higher Education and Disability would be excellent resource persons to identify faculty and staff, including science and engineering professors and deans who have disabilities.

School district special education administrators and teachers serving on the team could identify other teachers and administrators, both special education and regular education, for inclusion in the workshop. High school science and mathematics teachers could be encouraged to attend along with special education teachers from their schools. This type of pairing or grouping could certainly facilitate follow-through in the home school. Further, these teachers are the ones most likely to know of students with disabilities who have interest in, and show promise for, careers in science and engineering.

Local parent organizations, such as those advocating for persons with learning disabilities, attention deficit hyperactivity disorders, and visual and hearing disabilities, could be contacted to generate interest and support from parents of students with disabilities. The parents, in turn, could encourage their sons and daughters to attend.

The many groups of people and organizations can be contacted initially through the mailing of a brochure, announcing the workshop and soliciting their registrations. An example of a brochure is included in Appendix B. The design of the sample brochure makes it easy for mailing to potential participants and for them to complete the registration form and return mail it to you.

Small group facilitators will be needed for the small group sessions in the workshop program. You can select the facilitators from the people who register for the workshop. Pull from the list of workshop registrants those individuals whose professional roles and educational backgrounds qualify them for this responsibility. For example, teachers and counselors usually have good skills in working with groups. You will need one facilitator for each small group of seven to nine people. Including the facilitator, this means each small group will have eight to ten people. If you have 75 registrants, then you'll need to identify at least eight facilitators. Use the letter and instructions on the small group sessions (in Appendix C) and mail this to each of the ones you select to serve as facilitator. As a precaution, you'll probably want to recruit two extra facilitators to serve as alternatives, just in case they're needed. Give these persons a phone call a day or two ahead of the workshop to confirm attendance and answer any questions they might have.

Funding Support

Support for the workshop can be derived from corporate contributions, collaborative funding from the various participating organizations, and registration fees. Participating organizations, for example, could provide in-kind services, such as printing and mailing brochures, to cover some of the expenses. The corporation providing the facility may be willing to also provide lunch and coffee breaks. Whichever companies and organizations do provide direct or in-kind support, be sure to acknowledge them in the program brochure and during the workshop.

III. CONDUCTING THE WORKSHOP

Processing Participant Registrations

As the workshop registration forms are received, use either a telephone call or a postcard to respond to each registrant and confirm the registration. When doing this, you may also want to encourage each one to "spread the word" about the workshop and invite others to also register to attend. Should your response exceed 100 persons, then you'll need to decide which registrations to reject. This could simply be done on a "date received" basis. However, you may also want to consider the mix of people in your total group. If you do this, then you want to ensure representation among different groups, i.e., parents, students, secondary education, higher education, and so on.

On the day of the workshop, arrange for a check-in table. Have name tags, printed agendas, and other information available for registrants to pick up. You may want to have available a list of participants and speakers with names, addresses and telephone numbers. Any participants needing special assistance should be given information on how and where the assistance will be provided.

Establishing Small Groups

You will divide the workshop participants into small groups of seven to nine people each and assign a group facilitator to each group. With the registration information you have available before the day of the workshop, assign each participant to a group and give each group a unique number or name. Then put the group number or name on each individual's name tag. Assign individuals to groups on the basis of role and responsibility, i.e., to ensure each group is representative of the mix of people in attendance. The composition of one group, for example, might include a parent, two high school science teachers, a program director from a disabled student services program, a practicing engineer with a disability, a company personnel officer, a high school student with a disability, a university science professor, and a special education administrator serving as group facilitator.

On the morning of the workshop, meet with the small group facilitators prior to the registration check-in. Give the facilitators a brief orientation to the Nominal Group Technique process and answer any questions they might have from the information you had sent them in the mail earlier. Show them where the small groups will be meeting later in the day, the location of materials and supplies, and address any concerns or questions they might have. Let them know if any person in their group will need special assistance and tell them how it will be provided, e.g., interpreter service, personal assistant, and so on. Be sure to stress the structured format for the small group sessions and the importance of working within the format and time periods specified. This will ensure that the

group outputs and reports will be similar in format and that all groups will finish their work on the same time schedule.

Monitoring Workshop Activities

Your role as coordinator should leave you free of any other specific responsibilities on the day of the workshop. This will allow you to monitor and coordinate the flow of activities and intervene where necessary to keep things moving on track. Be prepared, for example, for people to show up on the day of the workshop and want to register. If space is available, you should be able to handle this, but you'll need to assign these people to small groups. Monitor the speakers and presenters to see that they stick to the schedule. If you run over time during the presentations, you can make up for this during the question and answer session. You'll need to work with facility personnel on setting up the sound system, audio-visual equipment, large meeting room and locations of the small group sessions. Lunch and break service will need to be coordinated with the food service personnel. You'll need to make sure the service is prompt and attends to special dietary needs of workshop participants. If you decide to show the video, "Science-Able," during the lunch session, you could set it up so that everyone will see it, or you may want to use a separate seating area for this option. When the small groups are in session, move around to each area to monitor group activity and be visible to the facilitators so that they can call on you easily if they need assistance. Remind the facilitators to keep their flip chart sheets so that these can be used for typing the results of each group for follow-up distribution to participants.

Audio and/or Video Recording

You may want to consider having the workshop presentations and question and answer session videotaped or audiotaped. This can provide an important record of your workshop proceedings. The audio tape or video tape could then be duplicated and distributed to workshop participants. If you want to do this, be sure to get permission from each speaker and presenter ahead of time and let the workshop participants know that this is going to happen. An alternative to audio or video recording would be to have speakers and presenters prepare written copies of their remarks or distribution at the workshop or for distribution afterwards. This puts an additional burden on the speakers and presenters which you may not prefer to do. But these are options to consider.

IV. EVALUATING THE WORKSHOP

At the conclusion of the small groups session, and following a short break, have each small group facilitator or someone else from each group give a report on the group's results. This should highlight the most critical strategies identified for overcoming barriers to career access. The discussion of these strategies should focus on their potential for implementation in the local area. The quantity and quality of the strategies developed by the small groups are measures of the workshop's success. While there will probably be overlap between groups, this is positive in that it helps to identify where there is consensus for where action needs to be taken in the future.

A participant evaluation form should be distributed after concluding remarks have been given, and each participant should complete this form. A workshop evaluation form is included in Appendix D.

V. FOLLOW-UP TO THE WORKSHOP

As follow-up to the workshop, communication with the workshop participants should include information on participants (to facilitate future networking), the results of the small group sessions, evaluation results, and recommendations or suggestions for future collaborative efforts. See Appendix E which contains a sample letter for giving feedback to workshop participants.

Participant Information

Each registered participant and workshop presenter should be listed by name, address, phone number, position title, and organization.

Evaluation Results

The outputs of each small group should be included in the follow-up mailing. These can easily be typed from the flip chart sheets, showing the strategies identified and the ones given highest priority. You'll need to do a tally of the responses on the evaluation forms and prepare a summary of the participant evaluations. These should also be included in the follow-up mailing.

Continuation of Collaborative Efforts

In your follow-up mailing, you have an excellent opportunity to set the stage for the continuation of collaborative efforts toward improving career access. Many of the people in the workshop will have come together for the first time to have focused attention on these issues. Seize the momentum and make some specific suggestions for continuing the collaboration through informal networking or organized meetings to fit your groups and local area.

VI. ADDITIONAL CONSIDERATIONS

As you plan and conduct the workshop on career access, you will find many helpful people and resources through your planning team. In addition to your local resources, there are some national resources and resources in other states which could be beneficial to you. We have included such a list in Appendix F.

Finally, we have compiled a checklist of items that may help you in the planning process. The workshop planning checklist in Appendix G is not intended to be exhaustive; rather, it is intended to be comprehensive in covering some of the most important elements to successful workshop planning.

Good luck!

APPENDIX A

BACKGROUND INFORMATION

The need for this project is supported by several factors.

First, projected occupational growth in science and engineering into the next century indicates a significant shortfall in meeting the needs of business, industry, government and higher education. Many positions currently go unfilled because there are too few graduates to meet the demand.

Second, individuals with disabilities have demonstrated that they can complete undergraduate and graduate programs in science and engineering, and can successfully pursue professional careers in business, industry, government, and higher education.

Third, while the number of students with disabilities attending college is increasing, students with disabilities are still significantly under-represented in science and engineering degree programs at the undergraduate level.

Fourth, it is increasingly being recognized that recruitment and retention of students with disabilities in science and engineering programs must begin during students' secondary school years (if not earlier) because decisions made during these years affect individuals' capacities and opportunities to pursue science and engineering in higher education.

Fifth, parents and teachers of students with disabilities have significant roles to play in fostering their sons' and daughters' interests in science and engineering and facilitating opportunities for them to move in this direction.

Industry's need for scientists and engineers means excellent career opportunities for students with disabilities. A Hudson Institute report, Workforce 2000: Work and Workers in the Year 2000, points out that the fastest-growing jobs will be in professional, technical, and sales fields requiring the highest education and skill levels (Johnston and Packer, 1987).

For natural scientists and engineers, the percentage of new jobs will almost double the number of current jobs. While the average rate of growth among occupations from 1984 to 2000 is projected at 25%, the rates of growth for technicians, health diagnosing and treating occupations, engineers, architects, and surveyors, natural, computer, and mathematical scientists, and social scientists place them among the fastest growing fields. For example, projected increases in demand among computer programmers (70%), electrical engineers (48%), mechanical engineers (33%), industrial engineers (30%), and mathematicians (29%) place these occupations among the career leaders (Career

Opportunities News, 1990).

This expansion of job opportunities will be fueled by the proliferation of advanced technologies in areas such as information storage and processing (terabytes, artificial intelligence), communications (digital telecommunications, fiber optic links), advanced materials (diamond coatings, ceramics, reinforced plastics), biotechnologies (agriculture, health care), and superconductivity (many diverse commercial applications). Individuals who are well-prepared educationally for these changes in the economy will be at a relative advantage compared to those who are not.

Despite an average annual growth in engineering employment in the United States of about 7% from 1972 to 1986 and a projected annual growth of at least 2% between now and the end of the century, the number of bachelor's degrees in engineering annually awarded by U. S. educational institutions crested in 1986 and continues to decline. Engineering enrollment has been dropping since 1982, and interest in engineering among native-born Americans is waning. In 1987 about 8.5% of all college freshmen expressed an interest in an engineering career, down from about 12% in 1982, according to annual data collected by the Cooperative Institutional Research Program, UCLA. Paul Holloway, Director of NASA's Langley Research Center, noted the "foundation for U. S. technology, economic and military leadership is eroding due to retirements and declining student interest...Freshmen student interest in science majors has declined over the past two decades. Interest in engineering is down by 25% since 1982. Interest in computing careers has fallen by more than 66% since 1982." (Holloway, 1992). Several reports document the problem—Education and Employment of Engineers, National Academy Press, 1989; America's Next Crisis: The Shortfall in Technical Manpower, Aerospace Education Foundation, 1989; and Science and Engineering Degrees: 1966-88, National Science Foundation, 1990 (Career Opportunities News, 1990). The National Science Foundation now predicts a shortage of 675,000 scientists and engineers in the United States by the year 2006 (Career Opportunities News, 1991).

Compounding the problem of declining science and engineering baccalaureate degrees awarded is a reduction in the number of college-age Americans, the traditional engineer-producing group. The total peaked by the early 1980s, and it will continue to decline at least until the end of the century. It's fair to assume, therefore, that business and industry organizations will be forced to look beyond their traditional sources of personnel; for qualified persons with disabilities, the opportunities will be unusually great.

Individuals with disabilities are a source of capable new students and workers. "Disabled persons are a great untapped resource for American business," according to Jack Honeck, Manager of Equal Opportunity Programs at IBM, as quoted in the Hudson Institute report, Opportunity 2000: Creative

Affirmative Action Strategies for a Changing Workforce (Hopkins and Johnston, 1988). This report emphasizes that the disabled community is an important, though often overlooked, source of capable new workers for businesses seeking to improve their competitiveness in the labor-short 1990s and beyond. In the fields of science and engineering, the National Science Foundation estimated that in 1986, of the four million scientists and engineers in the U. S., only 94,000 or about two percent identified themselves as disabled. Engineering and computer science were the most frequent field choices of persons with disabilities. The Task Force on Women, Minorities, and People with Disabilities in Science and Technology (1989) noted that:

> Technology is making it practical for people with disabilities to pursue careers where intellectual ability, and not physical prowess, begets success. For example, reading machines can provide blind persons with quick access to any document. Machines that translate voice into text in real time will soon enable hearing-impaired students to participate more easily in lectures and seminars. Wide dissemination of such aids can enable more people with disabilities to enter science and engineering. (p. 38)

Opportunities for persons with disabilities in science and technology are expanding as continued developments in the computer and electronic fields are creating opportunities for engineers, computer programmers, and others. Technology has opened many doors to learning, such that with proper accommodations, individuals with disabilities can perform nearly any job that the non-disabled population can.

Companies recruit at colleges and universities for job applicants with disabilities and advertise in such publications as Paraplegia News, Independent Living, and other periodicals directed to the disability community. They do so because they know from experience that persons with disabilities are, more often than not, highly safety-conscious, reliable, loyal, and motivated employees who perform well on the job, and who tend to keep their jobs. (Hopkins and Johnston, 1988). Today, hiring persons with disabilities is no act of charity, but good business sense. To illustrate this point, the Disability 2000 - CEO Council, formed by the National Organization on Disability, now includes over 300 Chief Executive Officers and corporate members, committed to the goal of expanded employment of people with disabilities by the year 2000.

The American Association for the Advancement of Science (AAAS), through a series of research projects and activities spanning more than a decade, has promoted career access opportunities in science and technology for students with disabilities (Stern, Lifton and Malcom, 1987; Task Force on Women, Minorities, and People with Disabilities in Science and Technology, 1989;

Lollar, 1991; Matyas and Malcom, 1991; and Raloff, 1991). AAAS' Project on Science, Technology and Disability has compiled a resource directory of practicing applied and research scientists and engineers with disabilities. The resource directory (revised and updated periodically) includes over 1,000 scientists and engineers as well as students with disabilities in science and technology. The directory serves as a resource for identifying scientists and engineers with disabilities who can serve as role models for others (Stern, 1978; Stern and Redden, 1979). In a videotape production called, "Science Abled," the AAAS promotes preparation of students with disabilities for the scientific and technological work force (Stern, 1987).

Despite increases in the numbers of programs and services for college students with disabilities, and the increased number of disabled students attending college, students with disabilities remain underrepresented in science and technology disciplines. During the past decade, programs to improve access and provide for students with disabilities at colleges, universities, and other postsecondary institutions have developed and expanded at a tremendous rate, including projects and programs with special emphasis on science and technology (Davis and McGowen, 1986; Redden and Stern, 1983; Zimmerman and others, 1983; and Jarrow, 1987).

Professional recognition of postsecondary programs and services for college students with disabilities was given in 1978 with the founding of the Association on Handicapped Student Service Programs in Postsecondary Education, which is now the Association on Higher Education and Disability (AHEAD). Association membership now includes over 1000 individuals who represent more than 700 disabled student service programs. In a survey of 258 disabled student service programs on college and university campuses, for example, Clark and Hughes (1990) found the average number of students served increased from 60 in school year 1986-87 to 117 students in school year 1988-89.

This proliferation of programs and students served was due to a combination of factors, including federal and state legislation and program initiatives, i.e., The Rehabilitation Act of 1973, as amended, the Americans with Disabilities Act, the Education of All Handicapped Children Act, and the Individuals with Disabilities Education Act (Wehman, 1993). Programs and services have provided more quality public education for adolescents and young adults with disabilities, preparing them to both want and succeed in postsecondary educational opportunities. According to a 1985 college freshman survey by the Cooperative Institutional Research Program at UCLA, 7.4 percent of college freshmen said they had a disability, up from 2.6 percent in 1978 (Hippolitus, 1987).

A more recent statistic on the percent of students with disabilities in postsecondary education comes from a 1987 National Center for Educational

Statistics study which reported 10 percent participation based on a survey of all recipients of federal financial aid (National Center for Education Statistics, 1989). No data are available on the percent of students with disabilities majoring in science and engineering. However, it is our sense that most professionals familiar with the subject feel that students with disabilities have interests in science and engineering similar to their non-disabled counterparts.

But, many of these students get deflected into other disciplines, so that actual program enrollment is less than for students who are not disabled. For example, the Task Force on Women, Minorities and People with Disabilities in Science and Technology (1989) observed that "low expectations are keeping students with disabilities from participating in a full mathematics and science curriculum, particularly in science laboratory courses." (p. 38). Anecdotal information also tends to support this conclusion. The National Association for Industry-Education (1994) noted, for example, that one disabled student service program coordinator at a large midwestern state university serving 150 students with disabilities reported zero students enrolled in science or engineering curricula.

The underrepresentation problem, many now recognize, is influenced by factors associated with educational experiences that occur well before college. This so-called "pipeline" perspective recognized that a myriad of influences and experiences affect an individual's interests and decisions leading into or away from a career in science and technology. A National Science Foundation study focussed on "critical incidents" in the lives of practicing scientists and college science students with disabilities to identify events and people that have turned these individuals toward careers in science and technology (Weisgerber, 1991).

The study population included 160 practicing scientists and 120 science students. Findings indicated that positive influences came from other people, often practitioners or teachers who sparked an interest and encouraged it to develop. Negative influences, on the other hand, came from teachers and counselors who encouraged students to go into the "soft" sciences and avoid the "hard" sciences, from parents' lack of knowledge about career opportunities in science and technology, and from vocational rehabilitation counselors who emphasized minimal employment as opposed to development of maximum potential. Further, there seems to be a tendency in middle and secondary special education programs to steer students with disabilities toward vocational-technical education programs of study which prepare students for work, but not for higher education (National Council on Disability, 1989).

Parents and students reported that school program administrators and teachers have low expectations for students with disabilities and establish inappropriate learning objectives and goals. These experiences are not dissimilar to those of non-disabled students (Graduating Engineer, 1989) as teachers and

guidance counselors encourage only the best students to go on to the higher level courses in mathematics and science education.

In most families, an adolescent's transition to adulthood is a stressful period. For families with children who have disabilities, the transition may be even more disruptive (Brotherson, Backus, Summers and Turnbull, 1986). Parents may feel confused and frustrated as they gather conflicting or incomplete information in their search for new services and educational opportunities beyond high school. Local school district task forces on transition have found that parents are not well informed about higher education options (Montgomery County Public Schools, 1985). Early parental involvement in transition planning is essential. The need for effective transition from secondary school to higher education is critical. Effective transition planning and parent participation during high school can facilitate the higher education success of students with disabilities (National Council on Disability, 1989).

In summary, this section on identification and significance of the problem or opportunity has emphasized several key points. Occupation demand for scientists and engineers is projected to exceed the supply of graduates well into the next century. This situation provides excellent opportunities for students with disabilities interested in these fields and qualified to pursue them. Business and industry recruit, hire, train and advance qualified persons with disabilities. Despite these opportunities, and the availability of programs and services to support college students with disabilities, they are still underrepresented in science and technology degree programs. Factors associated with underrepresentation include earlier educational experiences at the middle and secondary school levels. The role of parents in improving career access opportunities of students with disabilities in science and technology is critical in curricular decisions and in planning for the transition to higher education.

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APPENDIX B

Suggestions for Project Brochure

The brochure should be six-panel, single sheet, front and back.

Panel 1 (Vertical)

A N N O U N C I N G.....
A N N O U N C I N G.....
A N N O U N C I N G.....

A Special One-day Workshop on .....

Career Access in Science and Engineering

for Students with Disabilities

Name of Your City - Date of Your Workshop

Location

A N D Y O U ' R E I N V I T E D !!!

For more details, please look inside

Cooperating/Sponsoring Organizations

List your participating/supporting organizations here

Panel 2 (Horizontal, Perforated)

This panel will have your return address in the upper left corner, a space for postage in the upper right corner, and your address in the center. Persons interested in participating in the workshop will use this to return their completed information form.

Panel 3 (Vertical)

PROJECT PURPOSES

Study the issues involved in the underrepresentation in science and engineering of students with disabilities from the perspectives of:

- senior high school students with disabilities
- college students with disabilities
- parents of students with disabilities
- college science and engineering faculty
- college science and engineering administrators
- secondary special education teachers
- secondary special education administrators
- disabled student service program directors
- scientists and engineers with disabilities
- rehabilitation professionals
- representatives of business/industry

Identify barriers to career access opportunities and develop strategies to remove or overcome them.

Conduct a local/regional workshop using the nominal group technique process to generate, clarify, and prioritize the barriers and strategies information.

Disseminate conference proceedings and results to facilitate future collaborative efforts.

WHO SHOULD ATTEND THE ONE-DAY WORKSHOP?

The one-day workshop will be limited to 100 participants, with the participants representing a broad cross-section of persons. You should plan to attend if you are:

Panel 3 (continued)

- a high school student with a disability and an interest in science and technology
- a college student with a disability and an interest in science and technology
- a parent of a student with a disability who is interested in career opportunities in science
- a college faculty member teaching in science and engineering fields
- a college science or engineering department head
- a secondary special education teacher
- a special education program administrator
- a high school science or technology teacher
- a director or staff member of a college program providing services to students with disabilities
- a rehabilitation professional
- a high school guidance counselor
- a practicing scientist or engineer with a disability
- a representative of business/industry with an interest in hiring, promoting, training and developing persons with disabilities for careers in science and engineering

Please note: the workshop is limited to 100 persons due to the highly interactive nature of this process. Participants will not only hear from recognized leaders and experts, they will be actively involved in discussing the issues and barriers and identifying strategies to overcome them.

Panel 4 (Vertical)

WORKSHOP PROGRAM

8:30 Registration

9:00 Welcome and Opening Remarks

(Workshop Coordinator or Representative of Host Organization or both)

9:15 Conference Panel Presentations

"Industry's need for scientists and engineers means excellent career opportunities for students with disabilities."

(Representative of the business/industry community)

"Practicing scientists and engineers with disabilities—education and career experiences from those who have been there."

(Panel of scientists and engineers drawn from local business/industry and universities)

"Disabled student service programs: how they work, how they support, and how they can help the student with a disability pursue science/engineering at the college level."

(Local college or university program director)

"Parents' concerns and experiences."

(Parent-advocate from local organization)

10:00 Break

Panel 4 (Continued)

10:45 Question and Answer Session: Focus on identification of barriers to career access in science and engineering for students with disabilities.

11:30 Lunch

"Science-Able" A Video Tape Presentation

(Optional activity; available from: American Association for the Advancement of Science Project on Science, Technology and Disability)

12:30 Small Workshop Group Sessions: Developing strategies focusing on (1) career access in science and engineering and (2) those strategies that are directly related to the local area, i.e., specifically involving local school systems, parents' organizations, institutions of higher education, etc.

2:00 Break

2:15 Discussion of the Results of the Small Workshop Groups: A full exposition and exploration of the recommended strategies.

2:45 Workshop Evaluation and Concluding Remarks

(Workshop Coordinator)

Please direct workshop inquiries to: (give your name, organization name, and your phone number here).

Panel 5 (Horizontal, Perforated)

If you are interested in participating in the workshop, please complete, detach and mail to (name of your organization). You will be contacted to confirm your registration.

YES, I'm interested in participating in the workshop.

Name _____ Phone _____
Address _____
_____
_____
Present Position and Institution/Organization _____
_____
(If student, give level and school) _____
_____
_____
_____
Reason for Participation (give a brief explanation of why you would like to participate in the workshop, e.g., career interests, disability status, work experience and requirements)
_____
_____
_____
_____
_____
_____

Panel 6 (Horizontal)

This panel will have your organization's return address in the upper left corner, a place for postage in the upper right corner, and space in the center for affixing an address label or typing/writing addressee's name and address.

APPENDIX C

RECRUITMENT LETTER

SMALL GROUP FACILITATORS

Dear

I'm pleased to see that you plan to participate in the workshop on Career Access in Science and Engineering for Students with Disabilities in (city) on (date) . I am the workshop coordinator and represent one of the sponsoring organizations. As part of my role, I will be coordinating the afternoon small group sessions.

I would like to ask you to serve as a group facilitator. The facilitator's role is structured by the Nominal Group Techniques process we'll be using. A brief overview of the steps we will be following is enclosed. If you're not familiar with this techniques, I think you'll find it easy and interesting to learn. Plus, I will be guiding all of the small groups through the process during the session, and will be available to assist you.

I hope you'll agree to help us on (date) . You will need to arrive thirty minutes before registration starts for a brief orientation.

I will give you a call on (date) to confirm these arrangements.

Thank you for your consideration and assistance.

Sincerely yours,

Your Name
Your Title
Your Organization

Enclosure

Overview

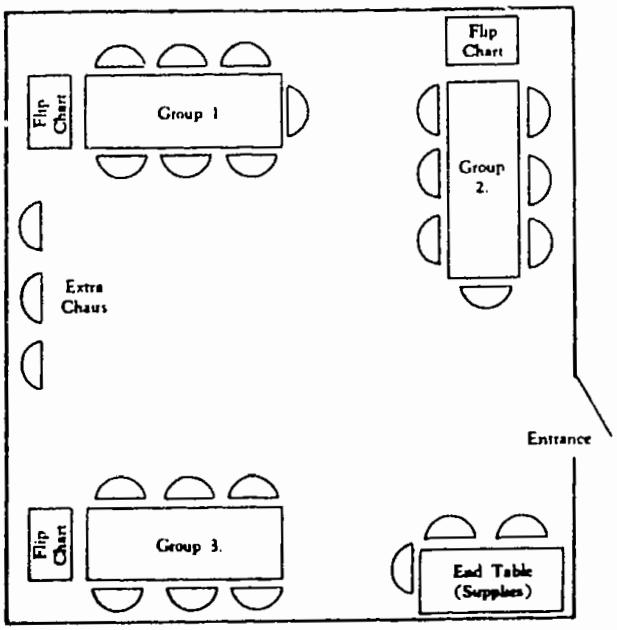
Nominal Group Technique Process

Career Access Workshop

The Meeting Room

The large meeting room will be divided into smaller areas, giving each of the small groups an area to work in, as indicated in Fig. 1 below. We will have up to 10 small groups of 9-10 members in each group.

Fig. 1 Meeting Room Arrangement for Three NGT Tables.



Supplies

These will be provided for each group: (1) flip chart for each table; (2) roll of masking tape; (3) pack of 3x5 index cards for each table; (4) felt pens for each table; and (5) paper and pencil for each participant.

Introduction to the Workshop Sessions

The coordinator will make a statement re: the importance of the task at hand, clarify the importance of each group member's contribution, and the use and purpose of the meeting's output. The coordinator will then introduce the nominal question to be addressed by the groups, e.g., "What are some strategies to overcome the barriers to career access in science and engineering for students with disabilities?"

Step 1. Silent Generation of Ideas in Writing

Write the nominal question on the flip chart.
Verbally read the question.
Have the group members, working silently and independently, write brief phrases or statements that address the nominal question. Group members with disabilities who need alternative ways of responding should be given this opportunity, aided by you or another group member, if needed.
Model good group behavior by writing your own ideas on paper.
Allow about 5 minutes for this step.

Step 2. Round-robin Recording of Ideas on the Flip Chart.

Go around the group and get one idea from each person.
Record the ideas as rapidly as possible on the flip chart.
Tear off completed sheets and tape them on the wall.
Note: This step maps the group's thinking; it's important to take one idea serially from each member; individual group members may "pass" and then "reenter" later; no discussion of ideas until the listing is completed—the purpose of this step is to get all the ideas down quickly and efficiently.
Allow about 20 minutes for this step.

Step 3. Serial Discussion for Clarification

Indicate that this step is to clarify the meaning of items and to explain reasons for agreement or disagreement; arguments are to be avoided since there will be an opportunity to express final judgments by voting.
Address one item at a time and allow any member of the group to comment on the item, not necessarily the member who suggested the item.
Pace the discussion so that no one item receives a disproportionate amount of time.
Allow the group to combine items where there is obvious duplication; but avoid combining items too much; if a member feels that items are different, then keep them as separate items.
Allow about 30 minutes for this step.

Step 4. Vote on Item Importance

Ask the group members to select from the entire list 5 priority or most important items.

Place each priority item on a separate 3x5 card (Fig. 2).

Rank-order the selected priority items, e.g., most important of the 5; most important of the remaining 4; most important of the remaining 3; most important of the remaining 2; and the remaining 1. When rank-ordering, assign the value of 5 to the most important of the 5 items, a value of 4 to the next most important, etc.

Collect the cards and shuffle them to retain anonymity.

Tally the votes and record the results on the flip chart (Fig. 3).

Allow about 15 minutes for this step.

Fig. 2 Index Card Illustrating Rank-Order Voting Process

Number from original group flip chart list (Figure 3-2)

5

Lack of skill in conducting this type of meeting

2

Note: The rank-order value of "2" indicates that this item was ranked 4th out of 5 items.

Fig. 3 Voting Tally Sheet on a Flip Chart with Recorded Votes and Rankings

Item #	Votes	Sum of Votes	X Number	= Total Vote	Rank
1.	3-2-1-3	9	4	36	3
2.	1-1-3-2-1	8	5	40	2
3.	4-5-5-4-3-4	25	6	150	1
4.					
5.					
6.					
7.					
8.	4-1-3	8	3	24	4
9.					

Note: The voting tally system takes into consideration how may group members voted for an item as well as how much importance they gave it.

Step 5. Report your Group's Results to the Coordinator.

APPENDIX D

Evaluation - Career Access Workshop - (Your City/Location) - (Date)

Part A: Please indicate the extent of your agreement or disagreement with each of the five statements pertaining to intended workshop outcomes. A rating of "1" indicates full agreement with the statement and a rating of "10" indicates full disagreement with the statement.

1. The workshop helped me better understand the issues which affect underrepresentation of students with disabilities in science and engineering.

   1.....2.....3.....4.....5.....6.....7.....8.....9.....10

2. The workshop helped me to identify important barriers to career access opportunities in science and engineering.

   1.....2.....3.....4.....5.....6.....7.....8.....9.....10

3. The workshop helped me develop some strategies to remove or overcome barriers to career access in science and engineering which I can use or certainly help implement.

   1.....2.....3.....4.....5.....6.....7.....8.....9.....10

4. Through the workshop, I've met people in other roles and with other perspectives that I can continue to learn from and work with as I try to improve career access.

   1.....2.....3.....4.....5.....6.....7.....8.....9.....10

5. The workshop registration procedures, meeting facilities, and other logistical arrangements contributed to the program's success.

   1.....2.....3.....4.....5.....6.....7.....8.....9.....10

Part B: Check the workshop activities/presentations which you found most helpful and informative. (Check all that apply.)

____	Industry needs	____	Disabled student services
____	Practicing scientists	____	Parents' concerns
____	"Science Able" video	____	Small group session
____	Q & A Session (a.m.)	____	Other: _____

_____

Part C: Please provide any additional comments on the value of the workshop, recommended changes, and suggestions for follow-up.

_____

_____

_____

_____

_____

Thanks for completing the evaluation form and for your participation today!

APPENDIX E

(Your organization letterhead)

Date

Participant
(Name of Your City/Location)
Workshop on Career Access

Dear Participant:

We are pleased to provide you with the results of the (Name of Your City/Location) workshop on "Career Access in Science and Engineering for Students with Disabilities."

As you will see from the results, the workshop hosted by (Name of company or organization), was very productive. All of the sponsoring organizations are very grateful for your participation and contributions.

Enclosed are the following:

1. List of workshop participants,
2. List of workshop speakers,
3. Results from each of the small groups, and
4. Summary of participants' evaluations.

As suggested by many, it is our hope that the workshop will be the "beginning" of a process that will continue to review the issues and begin to put into place some of the strategies to overcome the barriers you've identified. Excellent opportunities for networking exist!

(Put in this paragraph any specific follow-up plans that result from your workshop).

We wish you much success in your future efforts.

Sincerely yours,

(Your name)
(Your position title)

Enclosures

APPENDIX F

Resources - Materials and Organizations

Materials

"The Americans with Disabilities Act and Postsecondary Education." A brochure available from the Association on Higher Education and Disability, P.O. Box 21192, Columbus, OH 43221.

"Word Power and Disability." A booklet available from the Parent Network, 1443 Main Street, Buffalo, NY 14203.

Resources for Adults with Learning Disabilities, 1991-1992, and Transition Resource Guide, 1992. Both available from the HEATH Resource Center, American Council on Education, One Dupont Circle, Suite 800, Washington, DC 20036-1193.

Investing in Human Potential: Science and Engineering at the Crossroads (Executive Summary) Edited by Marsha Lakes Matyas and Shirley M. Malcom; Barrier-Free; In Brief booklets; and "Science Able" video tape. All available from the Project on Science, Technology and Disability, American Association for the Advancement of Science, 1333 H Street, N.W., Washington, DC 20005.

For a detailed presentation on the Nominal Group Technique Process, see Group Techniques for Program Planning, 1975, authored by A. L. Delbecq, A. H. Van de Ven, and D. H. Gustafson, published by Scott, Foresman Company, Glenview, IL.

Organizations

Association no Higher Education and Disability
P.O. Box 21192
Columbus, OH 43221
(614) 488-4972 (V/TDD)

HEATH Resource Center
American Council on Education
One Dupont Circle
Suite 800
Washington, DC 20036-1193
(800) 54-HEATH (V/TDD)

Project on Science, Technology and Disability
Directorate for Education and Human Resources Programs
American Association for the Advancement of Science
1333 H Street, N.W.
Washington, DC 20005
(202) 326-6630 (V/TDD)

The National Parent Network
Federation for Children with Special Needs
95 Berkeley Street
Suite 104
Boston, MA 02116
(617) 482-2915

The Disability 2000 - CEO Council
c/o National Organization on Disability
910 16th Street, N.W.
Suite 600
Washington, DC 20006
Note: Includes over 300 Chief Executive Officers and corporate members

Directorate for Education and Human Resources
Division of Undergraduate Science, Engineering
and Mathematics Education
National Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230

APPENDIX G

WORKSHOP PLANNING CHECKLIST

_____ Organized a planning team.

_____ Identified a barrier-free location.

_____ Identified sponsoring and supporting organizations.

_____ Determined date for workshop.

_____ Identified speaker representing business/industry.

_____ Identified speaker representing college/university disabled student service programs.

_____ Identified parent of a student with a disability to speak to parent concerns and experiences.

_____ Identified a panel of three to four practicing scientists and engineers with disabilities.

_____ Obtained funding support or set workshop fee to offset costs.

_____ Planned recruitment of participants from constituent groups.

_____ Prepared workshop brochure.

_____ Conducted mailing of workshop information and registration forms.

_____ Confirmed workshop participation with registrants.

_____ Identified small group facilitators for NGT process; mailed material.

_____ Confirmed small group facilitators' availability and attendance.

_____ Arranged for meal and break services, including special dietary needs.

_____ Arranged for special services, e.g., interpreter services, personal attendants, etc.

_____ Arranged for audio/visual equipment, including closed-captioned for persons with hearing disabilities.

_____ Assigned workshop participants to groups for small groups session.

_____ Prepared workshop forms: ___ evaluation; ___ agenda; ___ list of participants; ___ list of speakers; ___ name tags with group numbers.

_____ Compiled workshop results on "strategies" from each small group.

_____ Compiled participant evaluation results.

_____ Mailed feedback/follow-up letter to workshop participants.